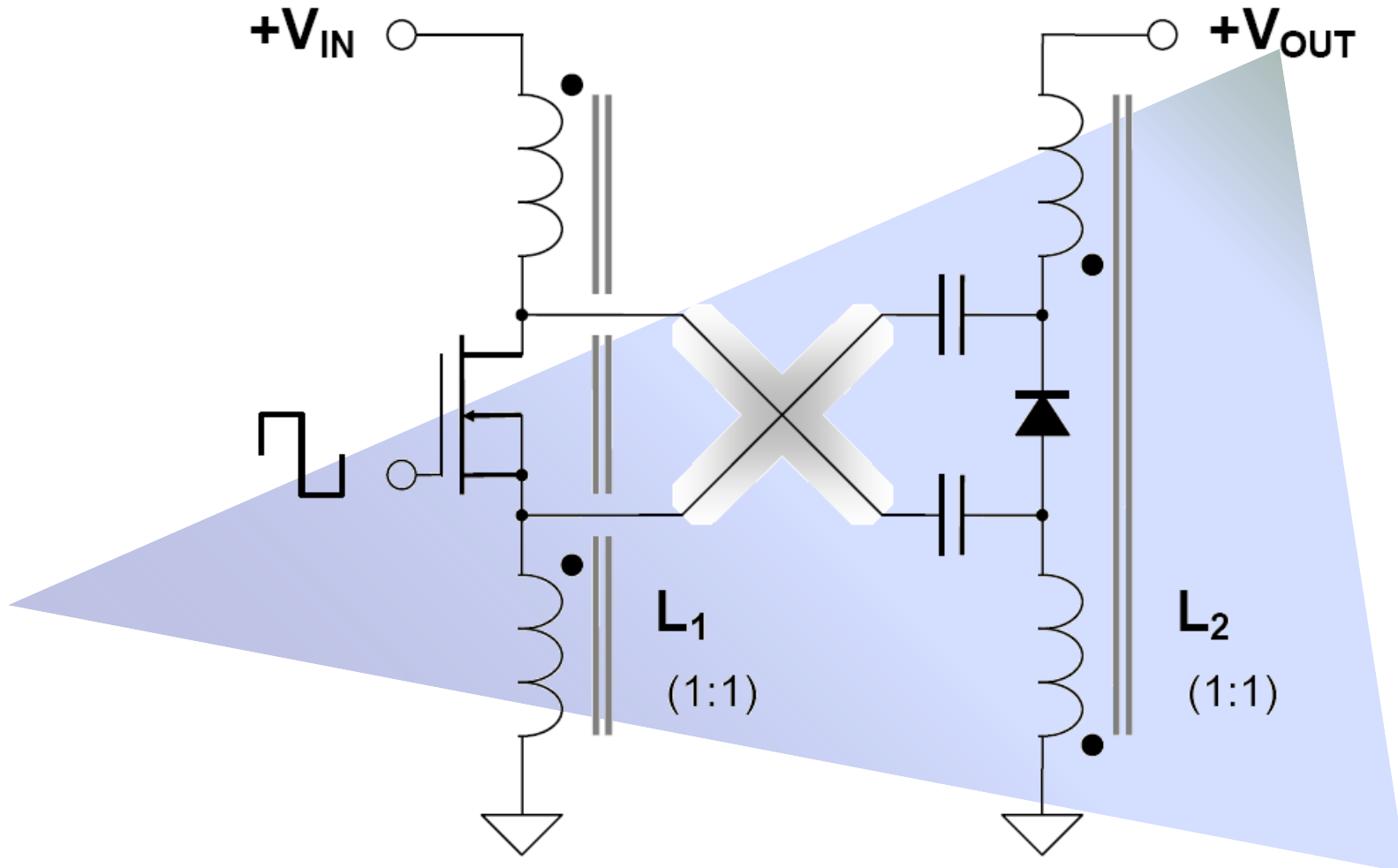


The X Converter

Dave Edwards

OutBack
Power Systems

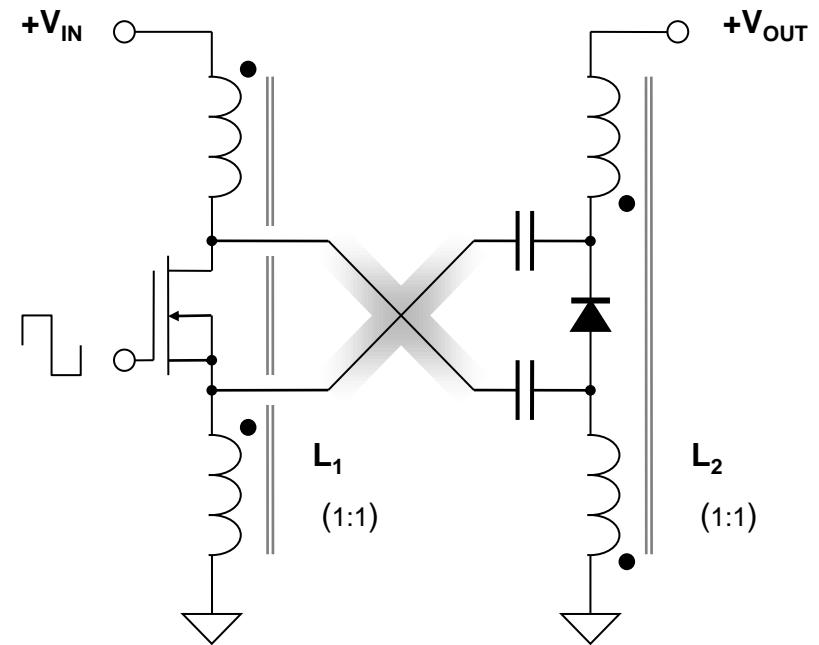


The X Converter

(Yet another new SMPS topology)



- Non isolated, single switch, **non inverting** buck-boost output.
- Based on the cross connecting of two independent split inductors.
- Continuous current on both input and output (ripple steering).
- Second order control-to-output response (with proper damping).



The X Converter!

The X Converter



What it *is* ...

- A little known buck-boost topology that provides a non inverting (non isolated) output using only a single switch;
- A topology that inherently provides continuous current on both input and output (about the same percentages as an equivalently size buck converter with an input filter);
- The optimum choice in certain, limited situations.

What it *is not* ...

- A Power Conversion Panacea (long live the basic buck and sliced bread);
- A zero ripple topology (these are like perpetual motion machines – they simply do not exist);
- The most appropriate topology for most power conversion applications.

The X Converter – History



- First discovered in the mid 1980s while analyzing the controversial (albeit highly entertaining) claims of Dr. Čuk[1] with regard to the universal superiority of his family of converter topologies.
- The X Converter was actually born from a true understanding of the workings of the double ripple “cancelled”, coupled core Čuk converter (*aka the Integrated Magnetics Čuk converter*).
- When presented with a schematic of the X Converter, Dr. Čuk stated that, although very intriguing, it was completely new to him.

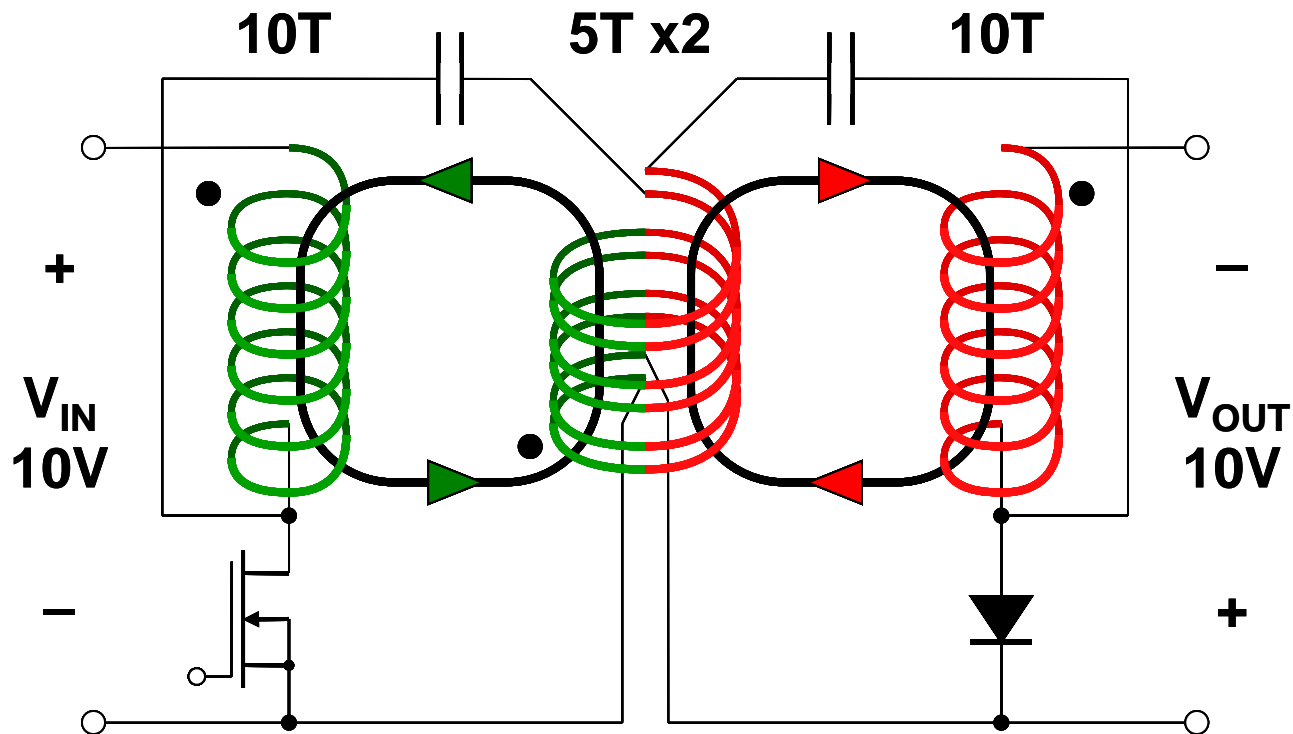
Integrated Magnetics

Original Reference



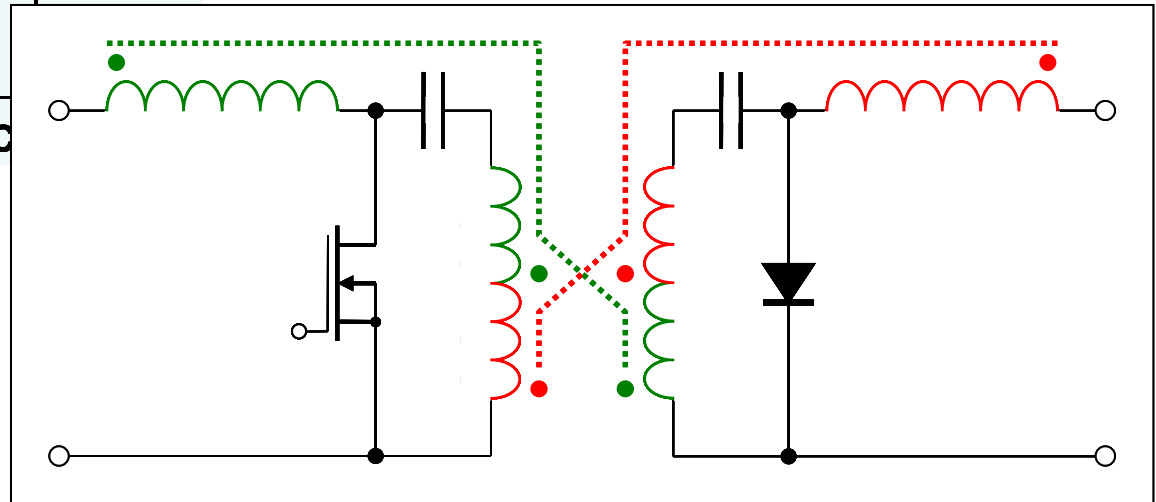
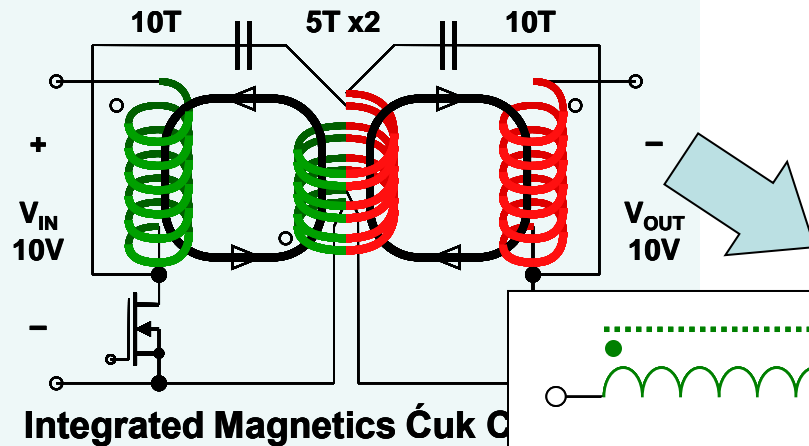
1. Ćuk, Slobodan,
“A New Zero-Ripple Switching DC-to-DC
Converter and Integrated Magnetics,”
Magnetics, IEEE Transactions on,
vol.19, no.2, pp. 57-75, Mar 1983

Deriving the X Converter

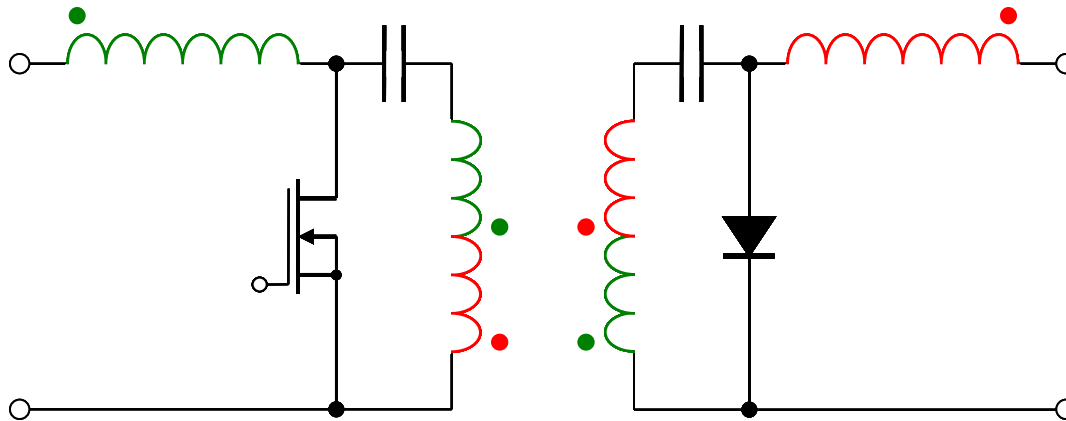


Integrated Magnetics Ćuk Converter

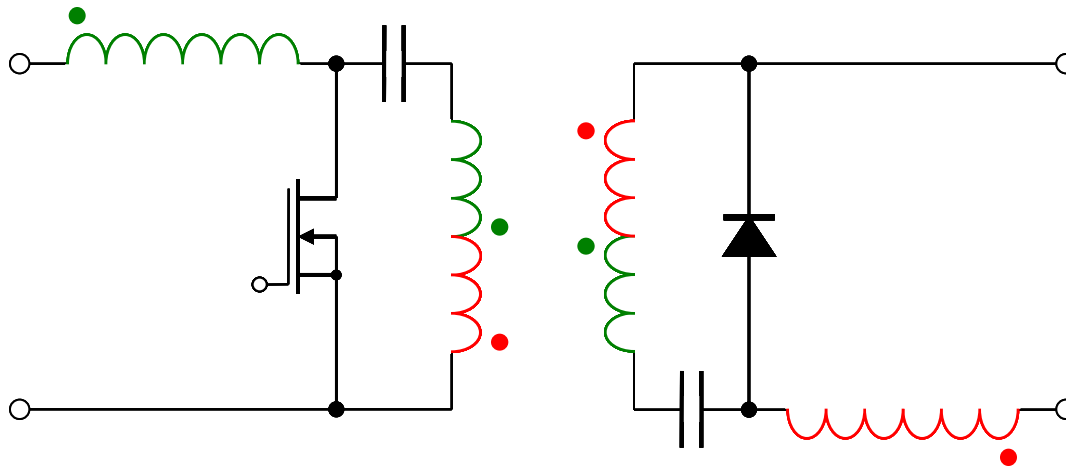
Deriving the X Converter



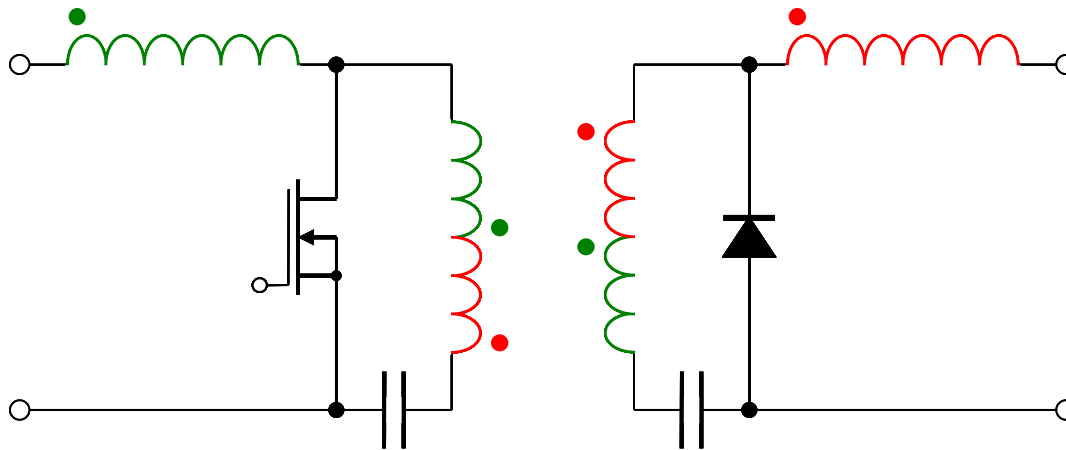
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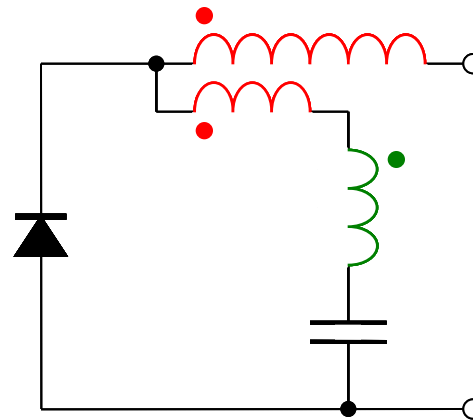
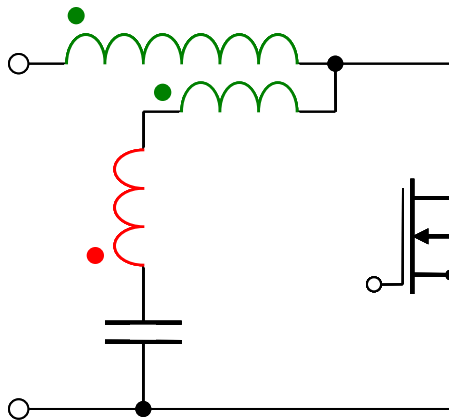
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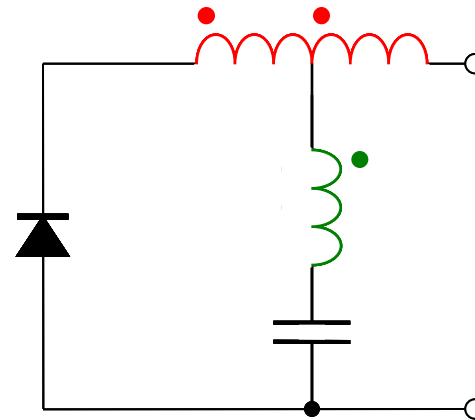
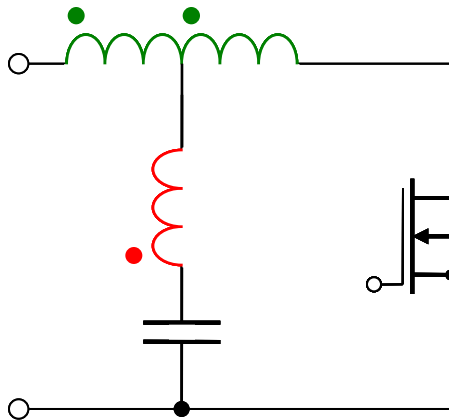
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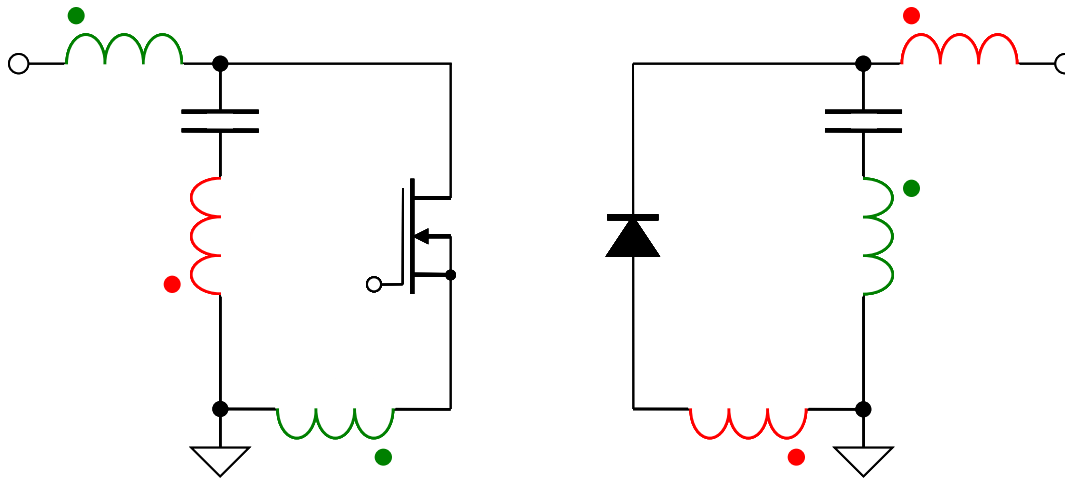
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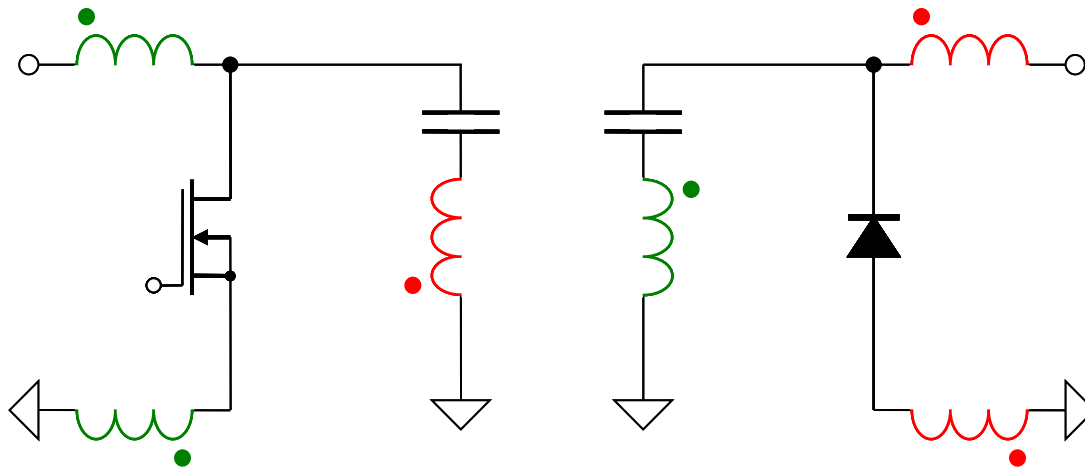
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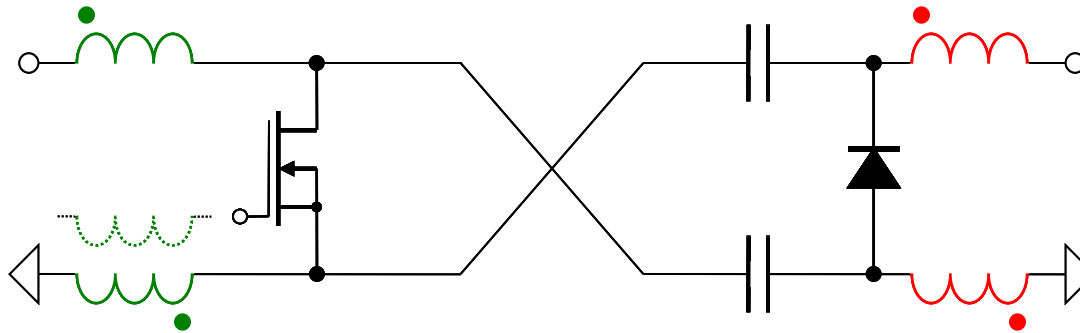
Deriving the X Converter



Deriving the X Converter



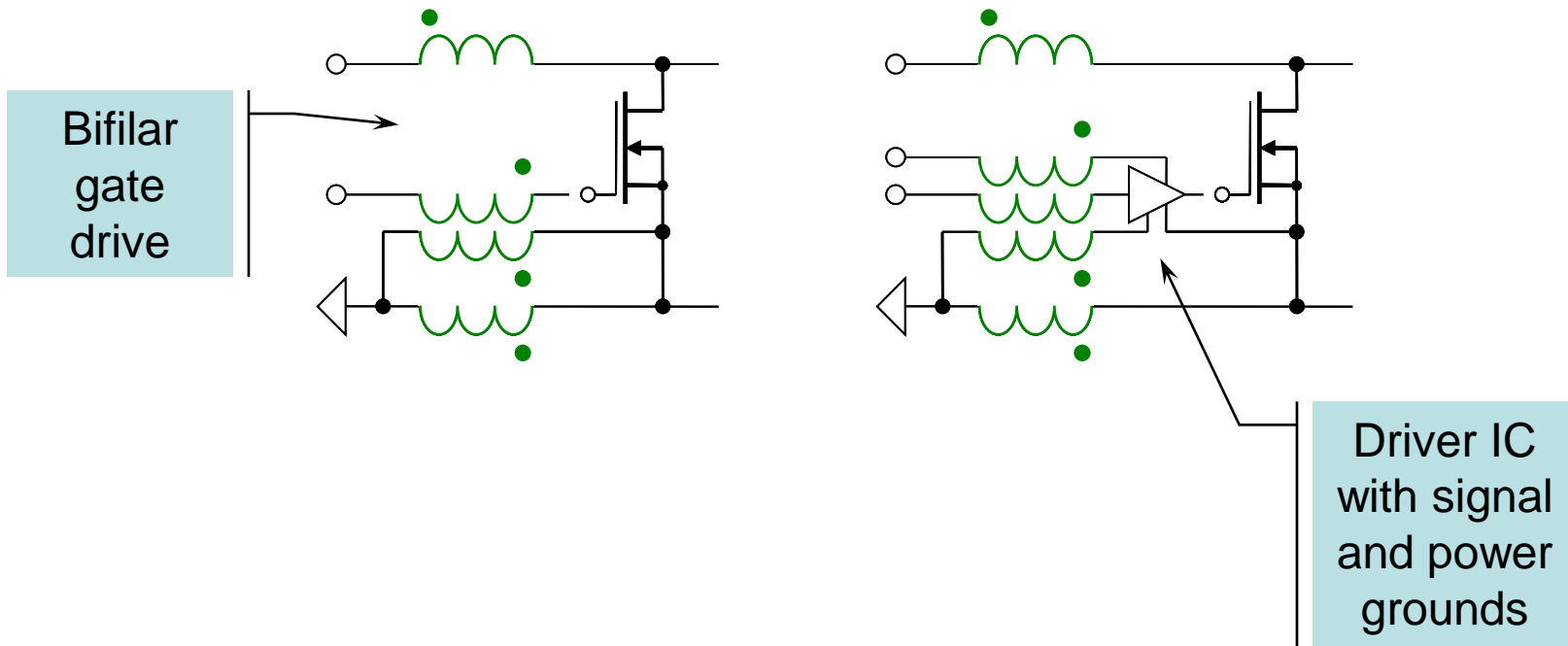
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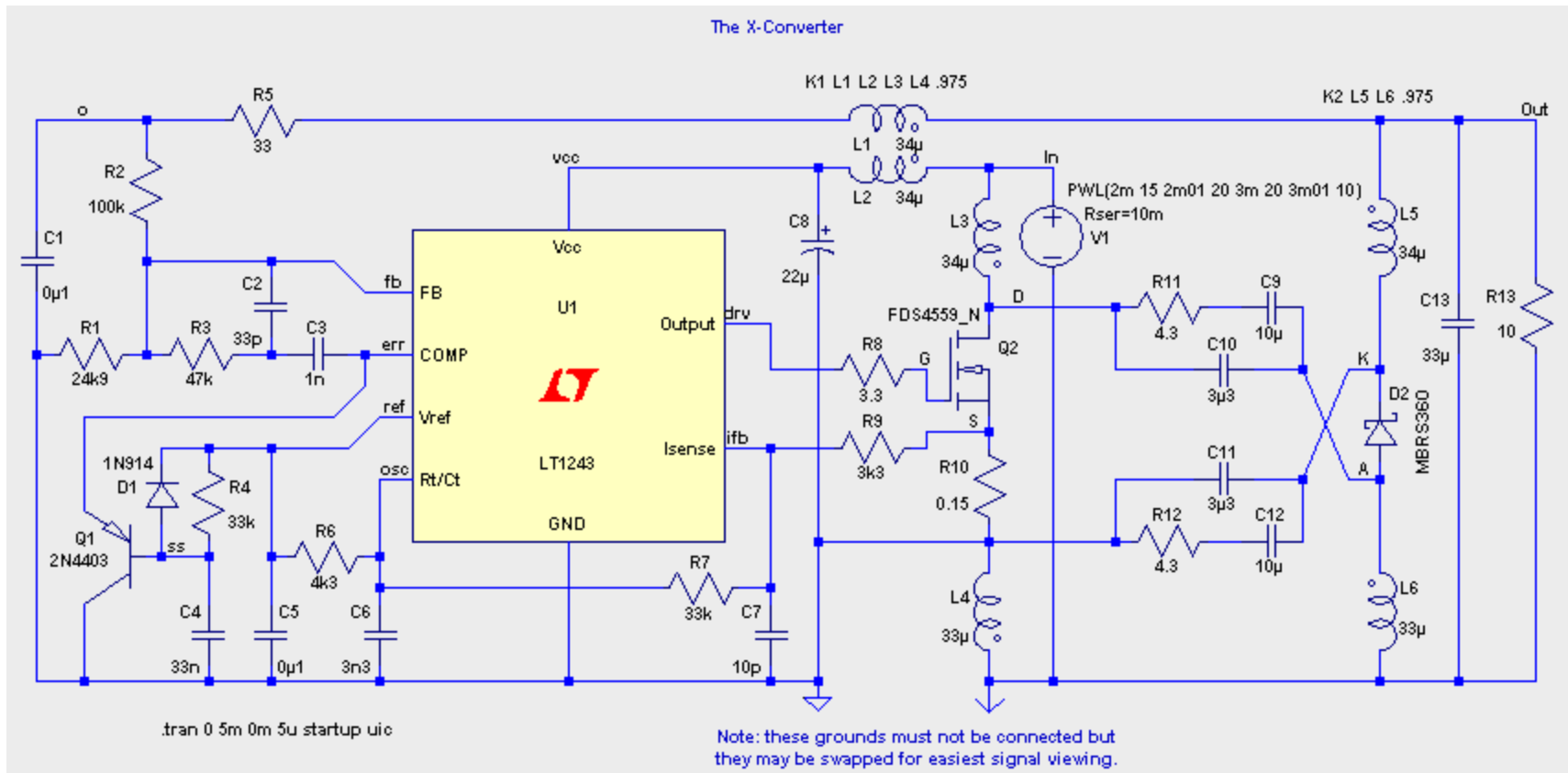
Driving the X Converter



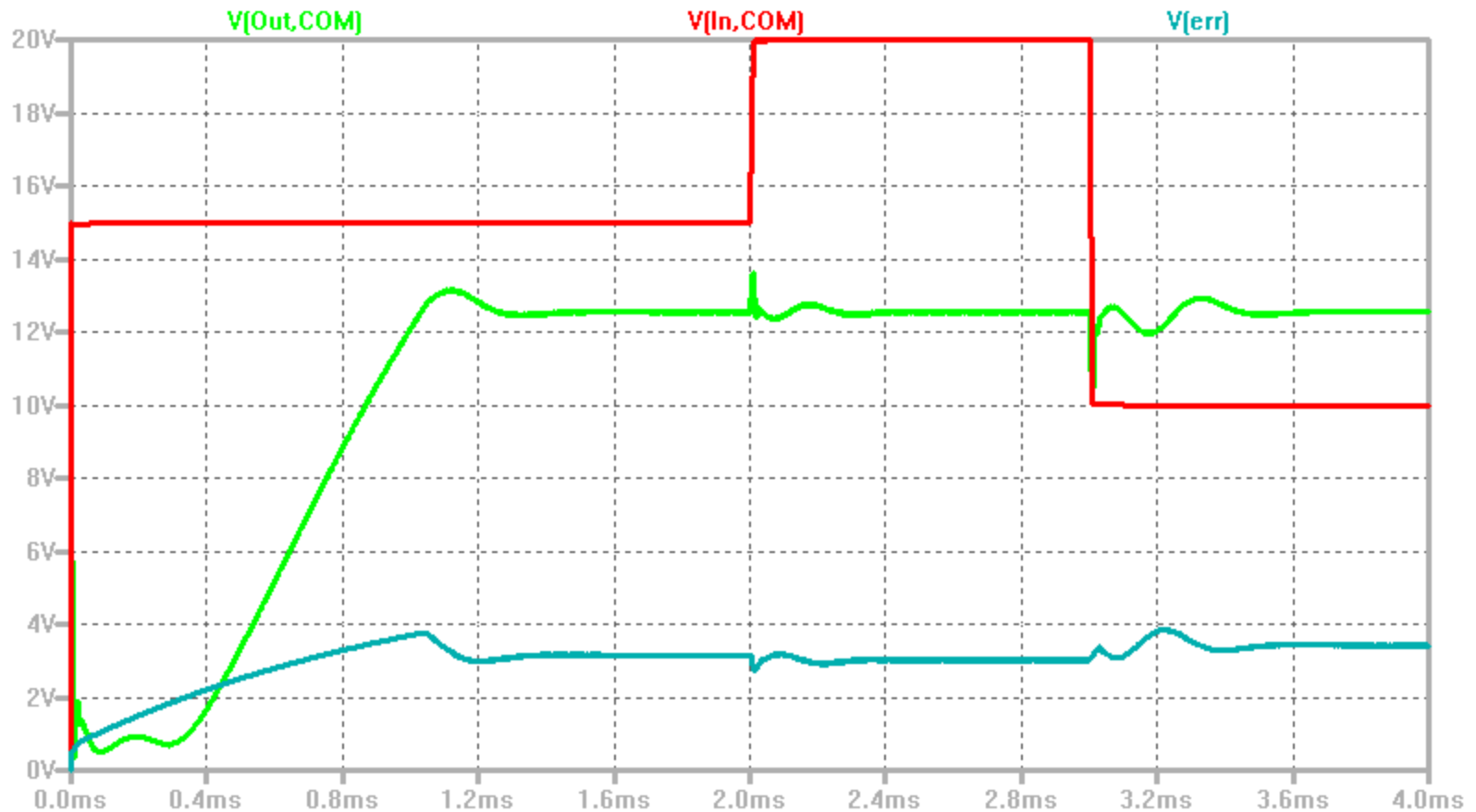
Bucking the common mode voltage with added drive windings



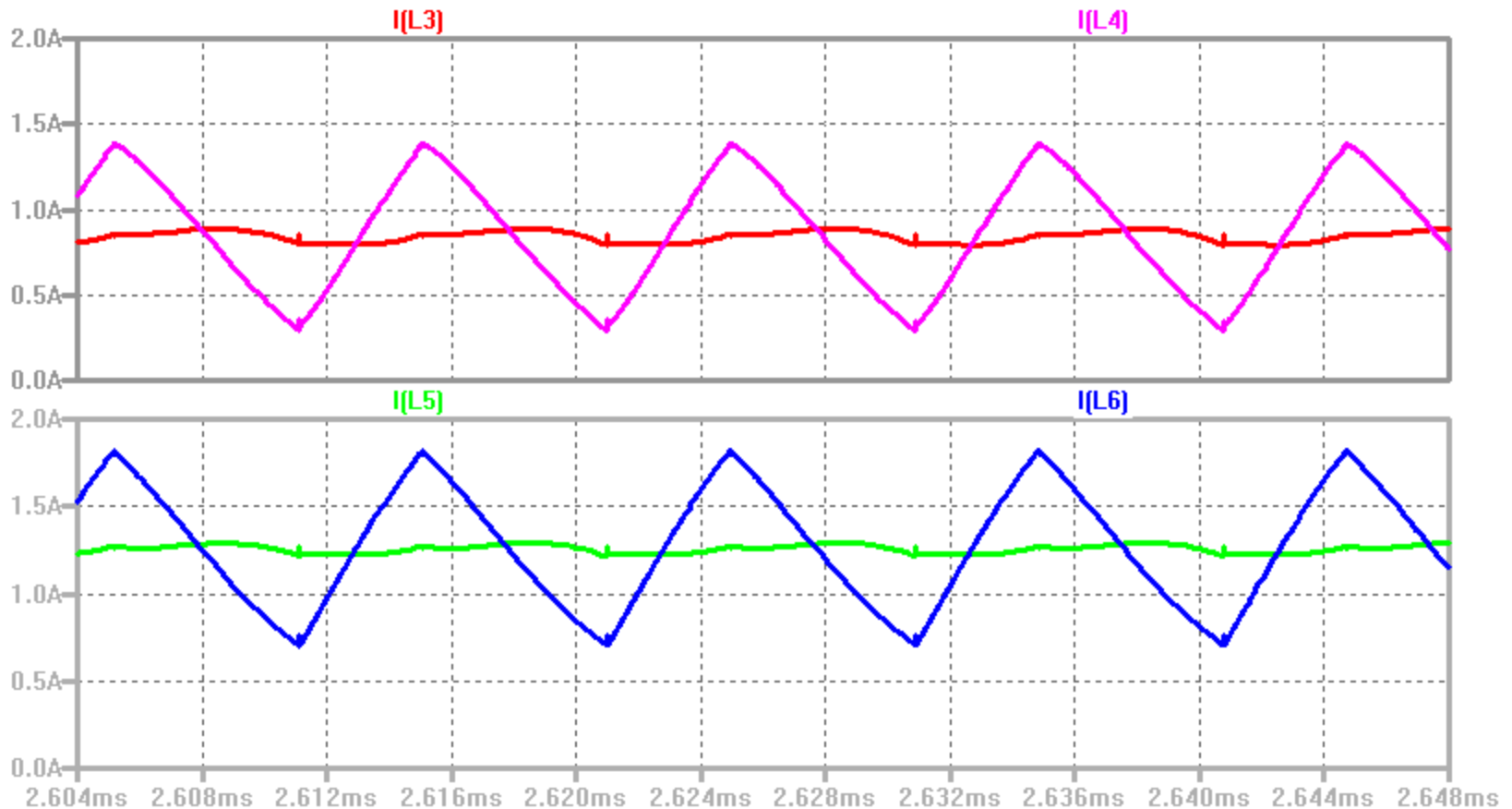
Driving the X Converter



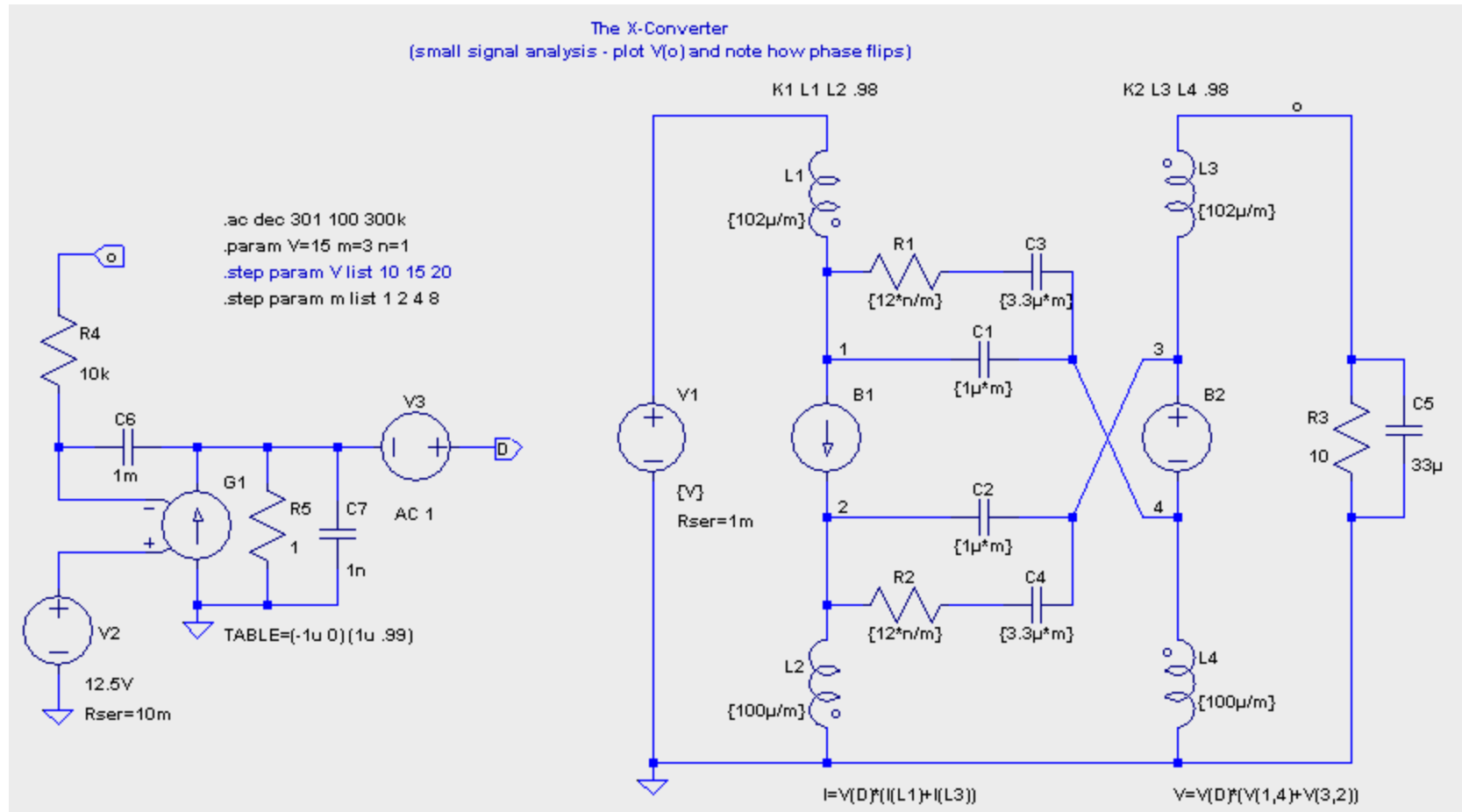
X Converter Line Step Response



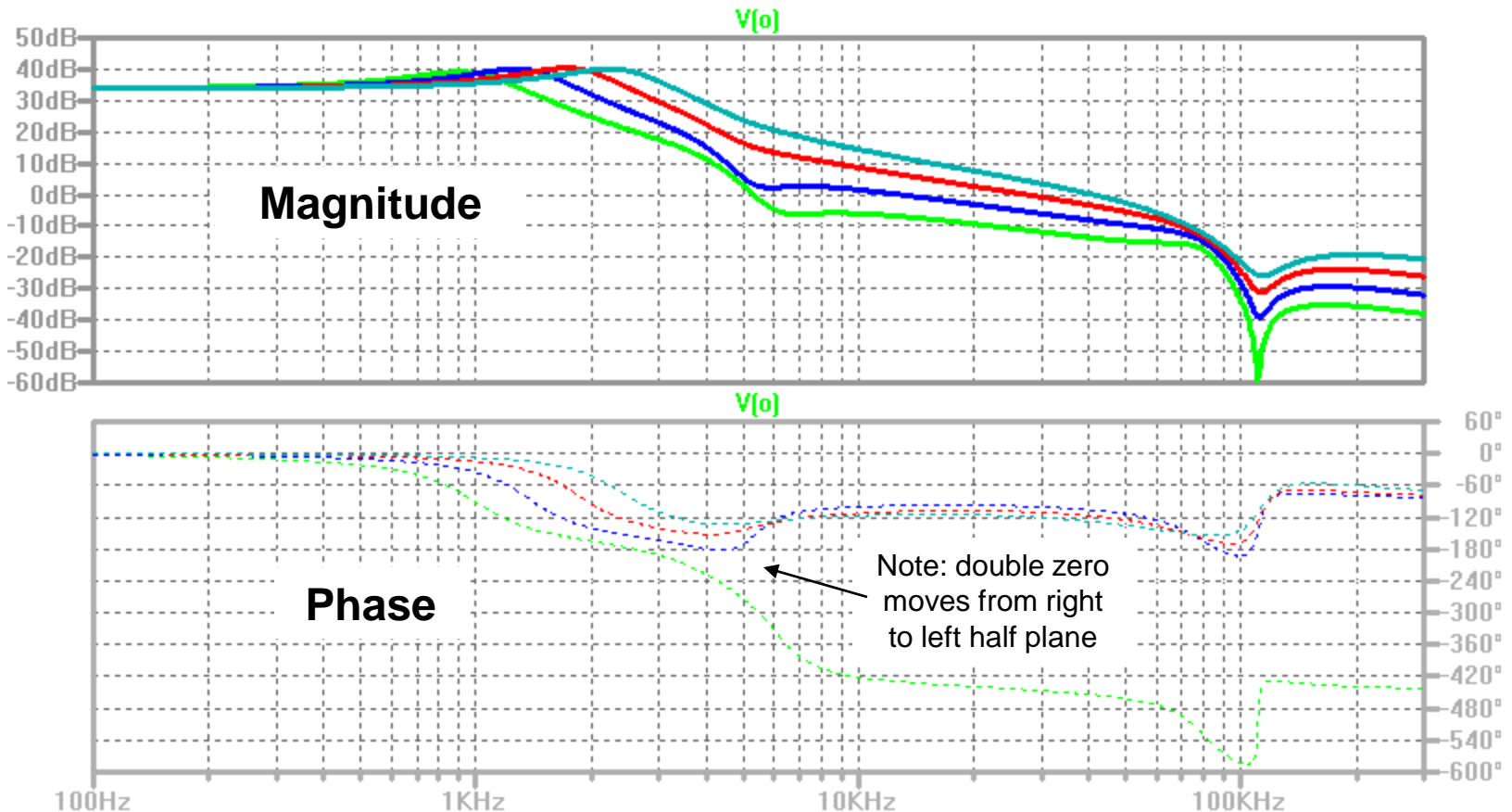
X Converter Inductor Ripple



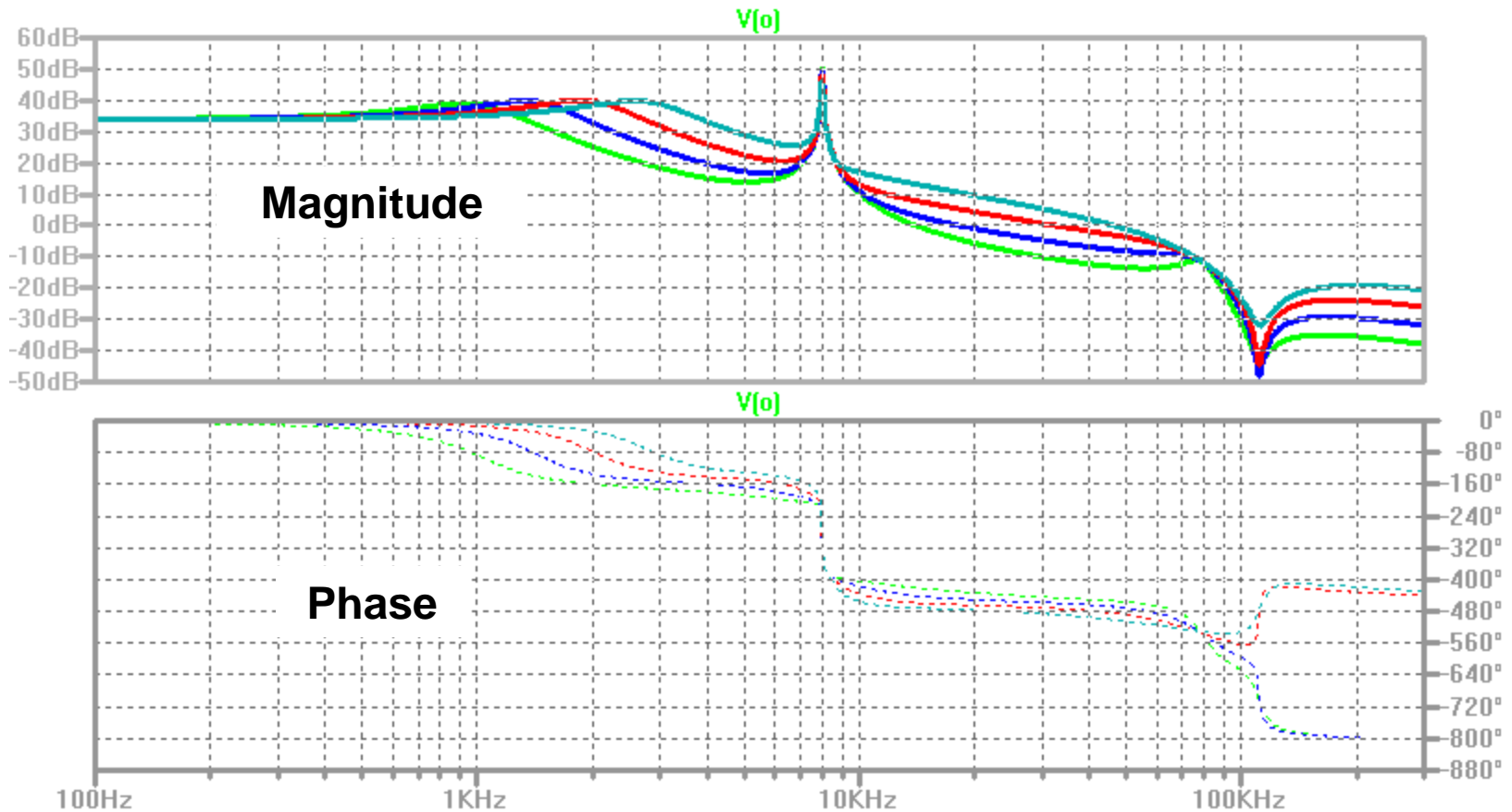
X Converter Duty Cycle to Output Transfer Function



X Converter Duty Cycle to Output Transfer Function



Response without Damping



Thank You !

